PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte Hakey

Appeal No. _____

Appellant:	Hakey et al.
Serial No.:	10/732,953
Filed:	December 11, 2003
Art Unit:	2891
Examiner:	David A. Zarneke
Title:	SHALLOW TRENCH ISOLATION FILL BY LIQUID PHASE DEPOSITION OF SiO_2

Cincinnati, OH 45202 January 5, 2007

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

BRIEF ON APPEAL

I hereby certify that this correspondence for Application No. 10/732,953 is being electronically transmitted to Technology Center 2891, via EFS-WEB, on January 5, 2007.

/William R. Allen/
William R. Allen, Reg. No. 48,389

January 5, 2007
Date

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BRIEF ON APPEAL

I. Real Party in Interest

The real party in interest is International Business Machines Corporation of Armonk, New York, which is the assignee of the present invention.

II. Related Appeals and Interferences

There are no related appeals or interferences known to Appellants or Appellants' legal representative that will directly effect or be directly effected by or have a bearing on the decision of the Board in the present appeal.

III. Status of the Claims

Claims 1, 2, 4-9, 12-14, and 22 are rejected and claims 3, 10, 11, 15-21, and 23 are cancelled. Claims 1, 2, 4-9, 12-14, and 22 are now on appeal.

IV. Status of Amendments

There have been no amendments filed subsequent to the final rejection dated October 2, 2006.

V. Summary of Claimed Subject Matter

Appellants' independent claim 1 is directed to method of forming shallow trench isolation regions in a silicon-on-insulator layer on a buried oxide layer. *See* Appellants' specification at page 7, line 1 – page 9, line 9 and FIGS. 2-6. The method comprises forming a shallow trench isolation region (e.g., 402) in the silicon-on-insulator layer (206) with sidewalls extending to the buried oxide layer (208) to define first and second active regions (e.g., 504 and 506) separated by the shallow trench isolation region (402), as best shown in FIGS. 4-6. The method further comprises selectively depositing silicon dioxide (502) in the shallow trench isolation region (402) without depositing the silicon dioxide (502) on the first and second active regions (504, 506) by nucleating the deposition of the silicon dioxide (502) on the buried oxide layer (208), as best shown in FIGS. 5 and 6.

As explained at page 8, lines 6-9 of Appellants' specification, "[t]he formation of silicon dioxide 502 is localized to the trenches and does not cover the active areas 504-512. Furthermore, the silicon dioxide 502 in each trench is formed without seams caused by the intersection of different growth fronts and, therefore, has a uniform etch rate across its entire surface." The difficulties associated with seam formation caused by nucleating growth of the silicon dioxide on the active areas and subsequent etching is explained at page 2, line 5 to page 3, line 2 of Appellants' specification.

VI. Grounds of Rejection to be Reviewed on Appeal

1. Claims 1, 2, 4-9, 13, 14, and 22 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Appellants' admitted prior art Fig. 1 (hereinafter *APA*) in view of U.S. Patent No. 5,994,178 to Wu (hereinafter *Wu*).

2. Claim 12 stands rejected under 35 U.S.C. § 103(a) as unpatentable over APA in view of Wu and further in view of U.S. Patent No. 5,851,900 to Chu et al. (hereinafter *Chu*).

VII. Argument

Appellants respectfully submit that the Examiner's rejections of claims 1, 2, 4-9, 12-14, and 22 are not supported on the record, and that the rejections should be reversed.

A. Claims 1, 2, 4-9, 13, 14, and 22 were improperly rejected under 35 U.S.C. § 103(a) as being unpatentable over *APA* in view of *Wu*.

The Examiner argues that claims 1, 2, 4-9, 13, 14, and 22 are unpatentable under 35 U.S.C. § 103(a) over *APA* in view of *Wu*. A *prima facie* showing of obviousness requires that the Examiner establish that the differences between a claimed invention and the prior art "are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art." 35 U.S.C. § 103(a). Such a showing requires that all claimed features be disclosed or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). All words in a claim must be considered in judging the patentability of that claim against the prior art. In re Wilson, 165 USPQ 494, 496 (CCPA 1970). Such a showing also requires objective evidence of the suggestion, teaching or motivation to combine or modify prior art references, as "[c]ombining prior art references without evidence of such a suggestion, teaching or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability -- the essence of hindsight." In re Dembiczak, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999).

Appellants respectfully submit that, in the instant case, the Examiner has failed to establish a *prima facie* case of obviousness as to any of the pending claims, and as such, the

rejections should be reversed. Appellants will hereinafter address the various claims that are the subject of the Examiner's rejection in order.

Independent Claim 1

The Examiner admits on page 5 of the October 3, 2006 Office Action that *APA* fails to teach "selectively depositing the silicon dioxide in the STI region without depositing the silicon dioxide on the first and second active regions." The Examiner contends on page 5 of the October 3, 2006 Office Action that *Wu* teaches "filling STI trenches with an LPD oxide." The Examiner further contends on page 6 of the October 3, 2006 Office Action that it would have been obvious to correct the deficiency of the *APA* with the disclosure in *Wu* because "Wu teaches the use of an LPD oxide to fill the STI trench produces a planar surface and lower budgets."

Wu discloses that silicon dioxide may be deposited in a shallow trench isolation region of a bulk silicon substrate using a deposition technique, namely liquid phase deposition, that is potentially selective. However, *Wu* fails to disclose that the deposited silicon dioxide (109) does not nucleate on the vertical side surfaces of the silicon active regions that border the sidewalls of the trench (108). A person having ordinary skill in the art would understand that silicon dioxide is nucleated by a selective deposition technique on any exposed silicon surface that is covered by a pre-existing oxide, such as native oxide. *Wu* fails to disclose that the vertical side surfaces of the active regions bordering the sidewalls of the trench (108) differ from the horizontal base surface of the trench (108). Presumably, each of these surfaces is silicon of the silicon substrate (101) that is covered by native oxide; otherwise the silicon dioxide (109) would not nucleate at all in the trench (108). Consequently, a person having ordinary skill in the art would understand that the silicon dioxide (109) selectively deposited in *Wu* nucleates on the vertical side surfaces of the active regions bordering the sidewalls of the trench (108) and also on the horizontal base surface of the trench (108). As a result, different growth fronts from each of the side surfaces of the silicon active region bordering the trench (108) and from the base surface of the trench (108) in *Wu* will intersect to form seams in the silicon dioxide (109) filling the trenches.

APA describes the deposition of silicon dioxide in a trench by conventional methods. As described in *APA*, "the silicon dioxide 112 in each trench includes seams 114

where growth fronts met when the silicon dioxide 112 was being formed." As further explained in the Background of Appellants' specification, this multiple front deposition represents a deficiency of conventional approaches for forming shallow trench isolation regions as seams are created when the different fronts intersect.

Wu fails to disclose that the deposited silicon dioxide (109) does not nucleate on the sidewalls of the trench (108). It follows that the combination of *APA* and *Wu* fails to teach all the claim limitations. Specifically, the combination of *APA* and *Wu* fails to disclose "selectively depositing the silicon dioxide in the STI region without depositing the silicon dioxide on the first and second active regions," as set forth in Appellants' claim 1. To establish a *prima facie* case of obviousness, the prior art references must teach or suggest all the claim limitations. *See* MPEP § 2143. Consequently, for at least this reason, the Examiner has failed to properly support that independent claim 1 is *prima facie* obvious. Reversal of the Examiner's rejection of claim 1 is therefore respectfully requested.

Moreover, *Wu* fails to provide a motivation or suggestion to modify *APA* so that the selectively deposited silicon dioxide fails to nucleate on the vertical side surfaces of the silicon active regions bordering the sidewalls of the trench. *Wu* fails to recognize any problems associated with multiple growth or deposition fronts when filling an isolation trench with oxide. Consequently, for at least this additional reason, the Examiner has failed to properly support that independent claim 1, as amended, is *prima facie* obvious. Reversal of the Examiner's rejection of claim 1 is therefore respectfully requested.

The Examiner states on page 5 of the October 3, 2006 Office Action that "Appellant's own specification states on the top of page 8; 'This deposition occurs in such a manner that the oxide nucleates on, and grows from, the exposed surface of the BOX layer 204'." The Examiner relies on this statement to conclude that "the LPD of oxide inherently nucleates and grows on the on the *(sic)* buried oxide." The Examiner's conclusion is a correct characterization of Appellants' invention. However, the Examiner's conclusion fails to consider the differences between the claimed invention as a whole and the prior art. Specifically, the Examiner has ignored that claim 1 sets forth that the silicon dioxide is selectively deposited in the STI region "without depositing the silicon dioxide on the first and second active regions." According to MPEP § 2141.02, "[i]n determining the differences between the prior art and the

claims, the question under 35 U.S.C. 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious." Consequently, the Examiner has failed to properly support that independent claim 1 is *prima facie* obvious. Reversal of the Examiner's rejection of claim 1 is therefore respectfully requested.

Dependent Claims 2, 4-9, 13, 14, and 22

Claims 2, 4-9, 13, 14, and 22, which depend from claim 1, are not argued separately.

B. Claim 12 was improperly rejected under 35 U.S.C. § 103(a) as being unpatentable over *APA* in view of *Wu* and *Chu.*

Dependent claim 12, which is not separately argued, is patentable for at least the same reasons as claim 1. Moreover, *Chu* fails to remedy the deficiencies of *Wu*. Specifically, *Chu* discloses intentionally lining the shallow trench isolation region with an oxide layer (22) to provide the selective deposition of silicon dioxide (24). *See Chu* at col. 4, lines 15-16. Consequently, the deposited silicon dioxide (24) will exhibit multiple growth fronts that intersect to define seams.

VIII. Conclusion

In conclusion, Appellants respectfully request that the Board reverse the Examiner's rejections of claims 1, 2, 4-9, 12-14, and 22, and that the application be passed to issue. If there are any questions regarding the foregoing, please contact the undersigned at 513/241-2324. Moreover, if any other charges or credits are necessary to complete this communication, please apply them to Deposit Account 23-3000.

Respectfully submitted,

WOOD, HERRON & EVANS, L.L.P.

Date: January 5, 2007

By: /William R. Allen/

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APPENDIX OF CLAIMS

1. (Previously Presented) A method of forming shallow trench isolation regions in a silicon-on-insulator layer on a buried oxide layer, the method comprising:

forming a shallow trench isolation region in the silicon-on-insulator layer with sidewalls extending to the buried oxide layer to define first and second active regions separated by the shallow trench isolation region; and

selectively depositing silicon dioxide in the shallow trench isolation region without depositing the silicon dioxide on the first and second active regions by nucleating the deposition of the silicon dioxide on the buried oxide layer.

2. (Previously Presented) The method according to claim 1, wherein the silicon dioxide is deposited by liquid phase deposition.

3. (Cancelled)

4. (Previously Presented) The method according to claim 1, further comprising:

forming a pad oxide layer on the silicon-on-insulator layer.

5. (Previously Presented) The method according to claim 4, wherein the pad oxide layer has a thickness between approximately 2 nm and approximately 10 nm.

6. (Previously Presented) The method according to claim 1, further comprising:

forming a pad nitride layer on the silicon-on-insulator layer.

7. (Previously Presented) The method according to claim 6, wherein the pad nitride layer has a thickness between approximately 10 nm and approximately 150 nm.

8. (Previously Presented) The method according to claim 1, further comprising:

cleaning the shallow trench isolation region before selectively depositing silicon dioxide.

9. (Previously Presented) The method according to claim 8, wherein cleaning the shallow trench isolation region reduces an amount of native oxide present along each exposed wall of the shallow trench isolation region.

10-11. (Cancelled)

12. (Previously Presented) The method according to claim 1, further comprising:

overfilling the shallow trench isolation region with an excess amount of the silicon dioxide during selective deposition; and

planarizing the shallow trench isolation region by removing the excess amount.

13. (Previously Presented) The method according to claim 1, further comprising:

processing the selectively deposited silicon dioxide to provide a density substantially similar to a density of thermally grown silicon dioxide.

14. (Previously Presented) The method according to claim 13, wherein processing the selectively deposited silicon dioxide further includes:

annealing the selectively deposited silicon dioxide at a temperature between approximately 800°C and approximately 1200°C.

15-21. (Canceled)

22. (Previously Presented) The method according to claim 6, further comprising:

forming a pad oxide layer between the pad nitride layer and the silicon-on-insulator layer.

23. (Cancelled)

APPENDIX OF EVIDENCE

(None)

APPENDIX OF RELATED PROCEEDINGS

(None)